CLAIMS

1. A spherical annular seal member which has a cylindrical inner surface defining a through hole in a central portion thereof, an outer surface formed in the shape of a partially convex spherical surface, and an annular end face on a large-diameter side of the outer surface, and which is used particularly in an exhaust pipe spherical joint, comprising: a reinforcing member made from a compressed metal wire net and provided in an inner portion of said spherical annular seal member which extends from the cylindrical inner surface to the outer surface formed in the shape of the partially convex spherical surface; a heat-resistant material containing expanded graphite, phosphorus pentoxide, and a phosphate, and provided in the inner portion of said spherical annular seal member which extends from the cylindrical inner surface to the outer surface formed in the shape of the partially convex spherical surface, said heat-resistant material filling meshes of said metal wire net of said reinforcing member and compressed in such a manner as to be formed integrally with said reinforcing member in mixed form, the outer surface formed in the shape of the partially convex spherical surface being formed into a smooth surface where an outer surface layer of said heat-resistant material containing expanded graphite, phosphorus pentoxide, and the phosphate and said reinforcing member made from the metal wire net and formed integrally with said outer surface layer in mixed form are exposed.

2. A spherical annular seal member according to claim 1, wherein the cylindrical inner surface is formed of said heat-resistant material containing expanded graphite, phosphorus pentoxide, and the phosphate.

3. A spherical annular seal member according to claim 1, wherein the cylindrical inner surface is formed of said reinforcing member made from the metal wire net.

4. A spherical annular seal member according to any one of claims 1 to 3, wherein the annular end face is formed of said heat-resistant material containing expanded graphite, phosphorus pentoxide, and the phosphate.

5. A spherical annular seal member according to any one of claims 1 to 4, wherein said heat-resistant material is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

6. A spherical annular seal member according to any one of claims 1 to 5, wherein the phosphate is selected from lithium primary phosphate, lithium secondary phosphate, calcium primary phosphate, calcium secondary phosphate, aluminum primary phosphate, and aluminum secondary phosphate.

7. A spherical annular seal member which has a cylindrical inner surface defining a through hole in a central portion thereof, an outer surface formed in the shape of a partially convex spherical surface, and an annular end face on a large-diameter side of the outer surface, and which is used

particularly in an exhaust pipe spherical joint, comprising: a reinforcing member made from a compressed metal wire net and provided in an inner portion of said spherical annular seal member which extends from the cylindrical inner surface to the outer surface formed in the shape of the partially convex spherical surface; a heat-resistant material containing expanded graphite, phosphorus pentoxide, and a phosphate, and provided in the inner portion of said spherical annular seal member which extends from the cylindrical inner surface to the outer surface formed in the shape of the partially convex spherical surface, said heat-resistant material filling meshes of said metal wire net of said reinforcing member and compressed in such a manner as to be formed integrally with said reinforcing member in mixed form, the outer surface formed in the shape of the partially convex spherical surface being formed into a smooth surface where an outer surface layer of a lubricating composition containing at least boron nitride and at least one of alumina and silica and said reinforcing member made from the metal wire net and formed integrally with said outer surface layer in mixed form are exposed.

8. A spherical annular seal member according to claim 7, wherein the cylindrical inner surface is formed of said heat-resistant material containing expanded graphite, phosphorus pentoxide, and the phosphate.

9 A spherical annular seal member according to claim 7, wherein the cylindrical inner surface is formed of said reinforcing member made from the metal wire net.

10. A spherical annular seal member according to any one of claims 7 to 9, wherein the annular end face is formed of said heat-resistant material containing expanded graphite, phosphorus pentoxide, and the phosphate.

11. A spherical annular seal member according to any one of claims 7 to 10, wherein said heat-resistant material is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

12. A spherical annular seal member according to any one of claims 7 to 11, wherein the phosphate is selected from lithium primary phosphate, lithium secondary phosphate, calcium primary phosphate, calcium secondary phosphate, aluminum primary phosphate, and aluminum secondary phosphate.

13. A spherical annular seal member according to any one of claims 7 to 12, wherein said lubricating composition contains 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica.

14. A spherical annular seal member according to any one of claims 7 to 13, wherein said lubricating composition further contains polytetrafluoroethylene resin.

15. A spherical annular seal member according to any one of claims 7 to 12, wherein said lubricating composition

contains a mixture consisting of 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica, and further contains not more than 200 parts by weight of polytetrafluoroethylene resin with respect to 100 parts by weight of said mixture.

16. A spherical annular seal member according to any one of claims 7 to 12, wherein said lubricating composition contains a mixture consisting of 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica, and further contains 50 to 150 parts by weight of polytetrafluoroethylene resin with respect to 100 parts by weight of said mixture.

17. A method of manufacturing a spherical annular seal member which has a cylindrical inner surface defining a through hole in a central portion thereof, an outer surface formed in the shape of a partially convex spherical surface, and an annular end face on a large-diameter side of the outer surface, and which is used particularly in an exhaust pipe spherical joint, comprising the steps of:

(a) preparing a heat-resistant sheet member containing expanded graphite, phosphorus pentoxide, and a phosphate;

(b) preparing a reinforcing member made from a metal wire net obtained by weaving or knitting fine metal wires, superposing said reinforcing member on said heat-resistant sheet member, and convoluting a superposed assembly of said reinforcing member and said heat-resistant sheet member into a cylindrical form, so as to form a tubular base member;

(c) preparing another heat-resistant sheet member containing expanded graphite, phosphorus pentoxide, and the phosphate and forming an outer-surface-layer forming member which includes said another heat-resistant sheet member and another reinforcing member made from a metal wire net disposed in such a manner as to cover said another heat-resistant sheet member;

(d) winding said outer-surface-layer forming member around an outer peripheral surface of said tubular base member so as to form a cylindrical preform; and

(e) fitting said cylindrical preform over an outer peripheral surface of a core of a die, placing said core into said die, and compression-forming said cylindrical preform in said die in an axial direction of said core.

18. A method of manufacturing a spherical annular seal member according to claim 17, wherein said tubular base member is formed such that said heat-resistant sheet member is located on its inner surface.

19. A method of manufacturing a spherical annular seal member according to claim 17, wherein said tubular base member is formed such that said reinforcing member made from the metal wire net is located on its inner surface.

20. A method of manufacturing a spherical annular seal member according to any one of claims 17 to 19, wherein said tubular base member is formed such that widthwise end portions of said heat-resistant sheet member respectively

project from said reinforcing member in widthwise directions of said reinforcing member.

21. A method of manufacturing a spherical annular seal member according to any one of claims 17 to 20, wherein said heat-resistant sheet member is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

22. A method of manufacturing a spherical annular seal member according to any one of claims 17 to 21, wherein said another heat-resistant sheet member is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

23. A method of manufacturing a spherical annular seal member according to any one of claims 17 to 22, wherein the phosphate is selected from lithium primary phosphate, lithium secondary phosphate, calcium primary phosphate, calcium secondary phosphate, aluminum primary phosphate, and aluminum secondary phosphate.

24. A method of manufacturing a spherical annular seal member which has a cylindrical inner surface defining a through hole in a central portion thereof, an outer surface formed in the shape of a partially convex spherical surface, and an annular end face on a large-diameter side of the outer surface, and which is used particularly in an exhaust pipe spherical joint, comprising the steps of:

(a) preparing a heat-resistant sheet member containing expanded graphite, phosphorus pentoxide, and a phosphate;

(b) preparing a reinforcing member made from a metal wire net obtained by weaving or knitting fine metal wires, superposing said reinforcing member on said heat-resistant sheet member, and convoluting a superposed assembly of said reinforcing member and said heat-resistant sheet member into a cylindrical form, so as to form a tubular base member;

(c) preparing another heat-resistant sheet member containing expanded graphite, phosphorus pentoxide, and the phosphate and forming an outer-surface-layer forming member which includes said another heat-resistant sheet member, a lubricating sliding layer of a lubricating composition containing at least boron nitride and at least one of alumina and silica and coated on one surface of said another heat-resistant sheet member, and another reinforcing member made from a metal wire net disposed in said lubricating sliding layer;

(d) winding said outer-surface-layer forming member around an outer peripheral surface of said tubular base member with a surface of said lubricating sliding layer placed on an outer side, so as to form a cylindrical preform; and

(e) fitting said cylindrical preform over an outer peripheral surface of a core of a die, placing said core into said die, and compression-forming said cylindrical preform in said die in an axial direction of said core.

25. A method of manufacturing a spherical annular seal member according to claim 24, wherein said tubular base

member is formed such that said heat-resistant sheet member is located on its inner surface.

26. A method of manufacturing a spherical annular seal member according to claim 24, wherein said tubular base member is formed such that said reinforcing member made from the metal wire net is located on its inner surface.

27. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 26, wherein said tubular base member is formed such that widthwise end portions of said heat-resistant sheet member respectively project from said reinforcing member in widthwise directions of said reinforcing member.

28. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 27, wherein said heat-resistant sheet member is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

29. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 28, wherein said another heat-resistant sheet member is composed of 0.05 to 5.0 wt.% of phosphorus pentoxide, 1.0 to 16.0 wt.% of the phosphate, and 79.0 to 98.95 wt.% of expanded graphite.

30. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 29, wherein the phosphate is selected from lithium primary phosphate, lithium secondary phosphate, calcium primary phosphate,

calcium secondary phosphate, aluminum primary phosphate, and aluminum secondary phosphate.

31. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 30, wherein said lubricating composition contains 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica.

32. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 31, wherein said lubricating composition further contains polytetrafluoroethylene resin.

33. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 30, wherein said lubricating composition contains a mixture consisting of 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica, and further contains not more than 200 parts by weight of polytetrafluoroethylene resin with respect to 100 parts by weight of said mixture.

34. A method of manufacturing a spherical annular seal member according to any one of claims 24 to 30, wherein said lubricating composition contains a mixture consisting of 70 - 90 wt.% of boron nitride and 10 - 30 wt.% of at least one of alumina and silica, and further contains 50 to 150 parts by weight of polytetrafluoroethylene resin with respect to 100 parts by weight of said mixture.